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ERADICATION OF FERNS FROM PASTURE LANDS IN THE EASTERN UNITED STATES.

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KINDS OF FERNS THAT ARE WEEDS AND AREAS INFESTED.[1]

There are nearly 7,500 recognized species of ferns in the world, of which number over 200 are known to be native to the United States. A few species have become weed pests in this country, and it is to a discussion of the control of these weedy ferns that this bulletin is devoted.

The parts of the United States in which ferns are bad weeds are, principally, (1) the hill country of the Northeastern States and the higher portions of the Appalachian Mountain region as far south as Georgia, and (2) the Pacific coast country west of the Cascade Mountains. In the former region, which is the area covered by this bulletin, the principal weedy ferns are the hay-scented fern (*Dennstaedtia punctilobula*) and the brake (*Pteris aquilina*, formerly known as *Pteridium aquilinum*). Both kinds are sometimes called brakes, although this term is properly applied only to the latter species. In the Pacific coast section the brake is the most common weedy fern.

Several other species in the eastern region are sometimes annoying, but they occur largely in low and moist places and do not give much trouble on good pasture land. They are principally the cinnamon fern (*Osmunda cinnamomea*), the marsh fern (*Orthopteris thelypteris*), and the sensitive fern (*Onoclea sensibilis*).

[1] The writer is indebted to Mr. J. S. Cotton, of the Office of Farm Management, for valuable suggestions in making the experiments described in this bulletin.

NOTE.—This bulletin will be of interest to farmers in the hill country of the Northeastern States and the higher portions of the Appalachian Mountain region farther south.

SCOPE OF THIS BULLETIN.

This publication deals only with fern eradication in the Eastern States. Although the experiments here recorded were made with the hay-scented fern, there is every reason to believe that the methods found useful against this species would be equally applicable to the brake. It should be understood, however, that the fern referred to in the following pages is the hay-scented fern.

FIG. 1.—The hay-scented fern.

HABITS OF GROWTH OF THE WEEDY FERNS.

THE HAY-SCENTED FERN.

The hay-scented fern (fig. 1) has a perennial, very slender rootstock one-eighth to three-sixteenths of an inch in diameter, extensively creeping below ground parallel to the surface. From the rootstocks arise at short intervals the fronds, or leaves, of the plant. These fronds are 1 to 3 feet high and 5 to 9 inches wide when mature. The fruit dots occurring on the margin of the leaf bear the spores which are comparable to the seeds of seed-bearing plants.

This kind of fern grows in patches or clumps (fig. 2), the surfaces of which are raised above the rest of the land and are soft and spongy, consisting of an accumulation of dead fern and forest leaves. In these clumps the fern leaves grow so thickly that young grass has no opportunity to work in. Even if grass could get a start in the clumps, it would be smothered out when the fern leaves fall over and die on the coming of cold weather.

The hay-scented fern is rather particular as to location. It thrives in places partially protected from the sun's rays, such as northern, eastern, and western slopes, or in areas close to stone walls or trees. It is noteworthy that this fern is not found in places that are much trodden. Either the plants have been driven out by the trampling of animals or the soil is so compact that the fern can not get a start.

THE BRAKE.

The brake (fig. 3) has underground parts similar to those of the hay-scented fern, but the rootstocks are more stout and woody and creep longer distances below the soil surface. The brake also has the same methods of reproduction as the hay-scented fern. The plant

varies much in size; in the Eastern States it is 1 to 3 feet high, but on the Pacific coast it attains a height of 6 to 8 feet. The leaf blades are triangular and umbrella-like, 1 to 4 feet broad, and long and more or less three parted, the larger branches usually twice divided. At maturity the fruiting leaves have a continuous edging of spore cases, which shed the light-brown spores in great quantities.

In the Eastern States the brake is distributed somewhat more generally than the hay-scented fern, not being confined so exclusively to

FIG. 2.—A pasture in southern New York with a characteristic growth of hay-scented ferns.

the hill and mountain country. From its habit of being widely creeping, the brake does not occur in dense, well-defined patches, like the hay-scented fern (fig. 4).

CONTROL OF FERNS IN THE EASTERN STATES.

As the grazing of live stock is a prominent feature in the farming of the eastern region in which ferns are weeds, and as the area of available pasturage has been curtailed by the presence of the ferns, these weeds are looked upon as a serious pest. Moreover, since these lands for the most part are so steep and rocky as to prohibit cultivation, and since the ferns, unlike many other pasture weeds, can not be reduced in number by increasing the vigor and thickening the stand of the pasture grasses, a real problem in weed control is presented.

METHODS ALREADY IN USE.

The methods that have been adopted for eradicating ferns in the Eastern States are cutting or mowing, salting live stock, and cultivation.

CUTTING OR MOWING.

In 1557 Thomas Tusser wrote his "Five Hundred Pointes of Good Husbandrie," in which he said:

> In June and in August, as well doth appeere,
> Is best to mowe Brakes of all times of the Yeere.

FIG. 3.—The brake.

In 1911 a representative of the United States Department of Agriculture found a farmer in Delaware County, N. Y., who was following the identical method advised by Tusser and had greatly reduced the number of ferns in his pastures. (See fig. 5.) This farmer, Mr. W. J. Thomson, has found that attacking them twice a year greatly reduces the number of ferns, and that if the method is followed for two years in succession most of them disappear.

It is best to make the cuttings just previous to the time when the ferns mature their spores. This not only prevents propagation by means of spores but greatly weakens the rootstocks, which are at their most susceptible stage just previous to sporing. As the spores mature during the latter part of June in Delaware County, the proper time to make the first cutting in that region is about the middle of that month. New leaves spring up immediately, so that one more cutting must be made that season to prevent sporing. This second cutting should be made about the middle of August. It is highly important to observe the precaution that if either of the cuttings is put off until after the spores mature, the plants should not be disturbed during the remainder of that season, since mowing the ferns after the spores ripen seems to scatter the spores a great deal more than when the plants remain undisturbed.

The work of cutting must usually be done by hand (fig. 6), as the land is generally too rough to admit of the use of a mower. In a

pasture with an average quantity of fern, one man with a scythe can cover about 2½ acres in a day. The leafstalks are tender and are easily cut with a scythe.

The writer has found a number of farmers in the mountain-pasture district of North Carolina who have successfully used this method of eradicating ferns. The plan seems to be generally accepted as the best in that region.

Burning after cutting.—Mr. Thomson has found that burning over the fern patches after cutting serves as a further check to the pest.

FIG. 4.—A field infested with brakes, near Tacoma, Wash.

After the mowed fern leaves have become dry, fire is started on the windward side of the patch. Not all patches will burn completely, as there are varying quantities of combustible material in the areas. Where a fierce fire has passed over a patch the fern rootstocks are undoubtedly injured to a considerable extent.

SALTING LIVE STOCK IN FERN PATCHES.

Where ferns occupy very small areas on a farm certain methods may be used that would not be economical on a thickly infested piece of land. One of these methods is salting live stock in the fern patches. Dry salt is scattered on the plants when they are moist with rain or

dew. The stock eat and trample the plants in their effort to get the salt. This plan has been successful on at least one farm near Delhi, N. Y. Since the saltings must be rather frequent, the areas treated should be those that are easily accessible.

CULTIVATION.

There is no doubt that cultivation destroys ferns. The difficulty is that the steep and rocky character of the fern-infested land does not permit effective cultivation except on limited areas. Cultivation has been tried on Mr. Thomson's farm with indifferent success. When a piece of pasture was plowed up and put into small grain, followed by seeding to grass, the fern worked in again, so that it is now

FIG. 5.—General view in southern New York, showing land in the foreground on which hay-scented ferns have been eradicated by cutting.

as thick as formerly. Another piece of pasture land was well cultivated in potatoes and afterward seeded to grass. In this piece the fern was slower in working back, but later a fairly good stand of the weed was found. If the cultivation could have been continued for several years, permanent eradication of the fern might have been expected, but the character of the land prevented this treatment.

EXPERIMENTS IN FERN ERADICATION.

Having learned the value of the various methods already in use in controlling ferns, the question arose whether there were any other methods that might be more satisfactorily employed. Spraying with

plant poisons suggested itself as the most promising. Accordingly, experiments were planned in cooperation with Mr. Thomson to compare the value of spraying with cutting, as well as to learn something about the best way of getting a stand of grass and clover on the infested areas. These experiments covered a period of two years, 1912 and 1913.

EXPERIMENTS IN 1912.

The tests were made in two series. Series 1 consisted of spraying to kill the ferns, accompanied by seeding, liming, and fertilizing to encourage a stand of grass. All plats were sprayed twice except one, which was sprayed four times. Series 2 consisted of cutting, also accompanied by seeding, liming, and fertilizing. Each plat was cut

FIG. 6.—Cutting ferns with a scythe on a hillside.

twice. The two sprayings and two cuttings on the various plats were made about the middle of June and August, just preceding sporing time.

Sprayed series.—The number of sprayed plats was four, all being uniformly and fairly well set to ferns. The materials used were solutions of common salt, iron sulphate, and arsenite of soda, and in order to make the treatments comparable as to cost the quantities applied to the various plats were of equal value. The sprayer used was a hand bucket pump, which produced a fairly mistlike spray. The entire surface of the plat was treated, the grass as well as the ferns. One-half of each plat was limed and fertilized in June at the rate per acre of 300 pounds of acid phosphate, 150 pounds of muriate of potash, and 2,000 pounds of hydrated lime. The entire surface of

all the plats was seeded to a pasture mixture of grass and clover in August.

Cut series.—The number of cut plats was two. They were both treated alike as to cutting, but one of them was limed and fertilized in June and seeded in August, while the other was merely seeded in August.

EXPERIMENTS OF 1913.

It was the intention to duplicate the treatment of 1912 on all the plats. In the spring of 1913, however, it was evident that the results of spraying on the plats treated with salt and arsenite of soda in 1912 had been so effective that there was not much fern left on which to experiment. Accordingly, two new plats were laid out in 1913 to test the relative merits of these two materials. The quantities used were less, but were equal as to cost, as before. Each plat was sprayed twice.

In addition to these two plats, two small areas of the 1912 sprayed plats were sprayed with the same solutions described above to note their effect on the young seeding of grass and clover.

There were no cutting plats in 1913, as there were numerous places in the fields where the fern had been cut one year and also two years in succession. The cut plats of 1912 were untouched in 1913 in order to note the fighting qualities of the fern in the presence of the new seeding of grass and clover.

CONCLUSIONS FROM EXPERIMENTS AND OBSERVATIONS WITH FERNS.

CUTTING.

Cutting ordinarily is a cheaper method of handling ferns than spraying. With ferns at an average degree of thickness in a pasture a man ought to cover about 2½ acres a day. With labor at $1.50 the cost of cutting fern is about 60 cents an acre for each cutting, as compared with spraying with salt at about $1.05.

A further advantage of cutting is that it is less complicated than spraying and requires only the use of a tool with which all farmers are thoroughly familiar.

Still another advantage is that seeding to grass and clover can be made as soon after the first cutting as is desired. After the original stand of ferns is cut down, the subsequent growth is seldom so thick as to prevent young grass working in. The seeding can be done the same year that the work of eradication is started, so that by the following year a good growth of young grass and clover may be expected, which in itself contributes to the reduction of the number of ferns.

SPRAYING.

There is no doubt that salt is the best material for a spray solution against ferns. (See fig. 7.) The iron sulphate was ineffective. Arsenite of soda was effective, but its use involved some risk on account of its poisonous character to man and animals; furthermore, it is rather difficult to obtain except in the larger centers. Salt is very effective, is easily obtainable, and probably exerts an aftereffect favorable to grass. It is also relished by live stock, thus contributing to the destruction of ferns treated with it in pastures to which stock have access.

FIG. 7.—Fields in southeastern New York where the experiments in fern eradication were made. In the immediate foreground is the plat sprayed with salt solution, which accomplished the destruction of nearly all the ferns in one season.

The quantity of salt required to the acre depends, of course, on the thickness of the fern. The smallest amount used in the experiments was 600 pounds to the acre, and this was considerably more than was needed, even though the entire surface of the plats, both the fern and the grass, was treated. As the ferns seldom occupy more than one-third the surface of a pasture, 200 pounds to the acre is usually ample. In these experiments salt was used in almost a saturated solution, that is, 1 pound to about 1½ quarts of water. If desirable, a more dilute solution could be used.

The cost of spraying varies under different conditions and is here only estimated. The difficulty of hauling water up steep slopes is sometimes so great as to make spraying almost prohibitive. After the materials are hauled to the field, the work of spraying proceeds faster than cutting. With ferns of an average degree of thickness a man with a knapsack sprayer ought to cover about 5 acres a day. Assuming that 150 pounds of salt are used to the acre at a cost of one-half cent a pound and that 5 acres are covered in a day with labor worth $1.50, the cost of spraying with salt is $1.05 per acre for each application, not including the cost of hauling the materials. As the first spraying is the most expensive in labor and materials, this treatment may cost a little more than the amount mentioned, while the subsequent treatments will probably cost less.

One disadvantage of spraying is that it is a detriment to the growth of young clover. This means that the measures for encouraging the clover to work into the patches occupied by fern should be deferred until after the last spraying has been made. It is probable that the spray does not injure young grass to any great extent.

An advantage of spraying is that it may be employed in situations that are too stony for the efficient use of the scythe (fig. 8). There are also certain other situations where large spraying outfits may be satisfactorily used. Spraying with a barrel pump on a low wagon can sometimes be made more cheaply than with a knapsack outfit.

NUMBER OF TREATMENTS NECESSARY.

Two treatments a year, either spraying or cutting, seem to be about as effective as four, and are to be recommended. Undoubtedly the best time to treat the ferns is just previous to sporing, or about the middle of June and the middle of August.

BURNING.

Following a treatment of either spraying or cutting, fire may be started when the vegetation on the surface of the patches is dry. The burning not only kills the shoots that have recently started, but probably affects the vitality of the rootstocks as well. The subsequent growth of young shoots is usually not as vigorous as when the patches are not burned. The burning should be done, of course, before seeding to grass and clover.

HOW LONG SHOULD THE MEASURES OF ERADICATION BE CONTINUED?

It is probably not practicable absolutely to eradicate ferns. After they have been reduced to a minimum the specific methods of destruction may be discontinued, at least until the weeds again become troublesome. The reduction of the number of ferns will give the grass and clover ample opportunity to work in, and this in itself will tend to hold the ferns in check.

GETTING A STAND OF GRASS ON THE FERN PATCHES.

After the fern has been greatly reduced or entirely eradicated, grass is very slow in working into the patches unless certain measures are adopted. Of these measures, scattering grass and clover seed over the patches is the most important one. The stand is better and the growth more vigorous, especially in the case of clover, if lime and fertilizer are applied in addition to the seed.

Seed may be sown either in the early spring or late summer. In these tests the seed was applied at the latter period, that is, during

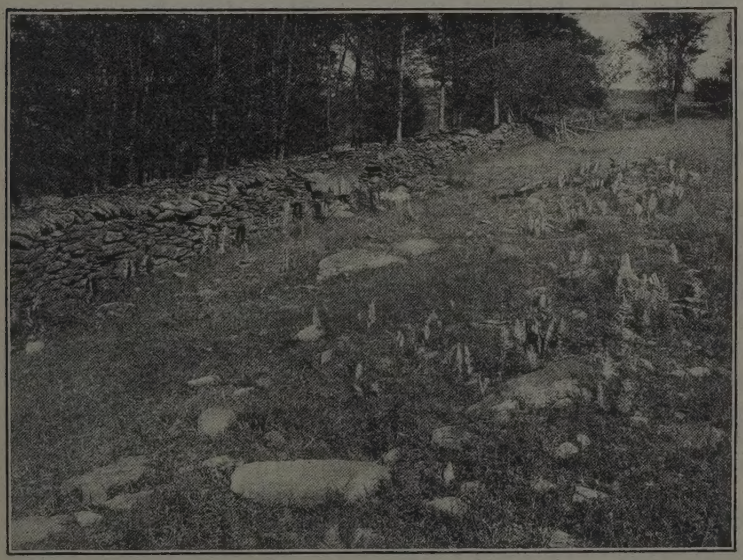

FIG. 8.—View of a pasture from which ferns have been eradicated, except among rocks and close to the stone fence, by cutting. This pasture presents conditions under which spraying with a salt solution may be the best method of eradication.

August, with excellent results. If the seeding be done at this time the young grass seedlings are less injured, probably by the shading effect of the ferns, than if done in the early spring.

CONTROL OF FERNS IN THE WESTERN STATES.

The brake is fully as serious a weed pest on the Pacific coast as are any of the fern species in the East. A thorough investigation of the fern problem of the Western States has not been made as yet by the Department of Agriculture. There is no doubt, however, that the ferns of that region may be subdued by the same methods used in the East, with certain modifications to meet local conditions, especially in the time of application of the treatments. Owing to the

nature of the land and the kind of farming in vogue on the Pacific coast there are several methods that can probably be used to advantage in that region that can not be employed in the East.

SUMMARY.

Two kinds of ferns have become serious weed pests in the United States, namely, the hay-scented fern and the brake. The two species are troublesome in the hill country of the Northeastern States and in the higher mountain country of the States farther south. On the Pacific coast the brake is the principal weedy fern.

This bulletin deals with the fern problem of the Eastern States. Although the experiments here recorded were made with the hay-scented fern, there is no doubt that the treatment found most effective with that species would apply equally well to the brake. Both kinds are perennials, with running rootstocks which lie more or less parallel to the soil surface.

In most parts of the East where the ferns are weeds the land is so steep and rocky that cultivation is not practicable. It has been found that cutting off the tops close to the soil surface twice a year for two years will kill out nearly all of the ferns. The best times to do the cutting are just previous to sporing, or about the middle of June and the middle of August in southern New York.

Experiments were made in 1912 and 1913 to test the efficacy of spraying as compared with cutting and to learn the best method of obtaining a stand of grass and clover on the fern-infested areas. The spray materials used were solutions of salt, arsenite of soda, and iron sulphate. These materials were used in quantities of equal value.

The results of these tests showed the following facts: Salt is the best spray material of the three. With ferns at an average degree of thickness on the land, 150 pounds of salt dissolved in 60 gallons or more of water to the acre for each application are sufficient. Two sprayings a year are about as effective as four, and are to be recommended. Cutting is somewhat cheaper than spraying. Furthermore, the cutting does not interfere with young clover and grass coming in on the infested patches after the first treatment. This method, therefore, is to be recommended in preference to spraying in most situations. In some places the land is so stony as to interfere with cutting, in which case spraying may be the best method. It was found that scattering seed on the patches where ferns had grown was the most important means of getting a stand of grass and clover, and that liming and fertilizing in addition to the seeding were of considerable benefit.

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